

CLAIMS

1. A method for manufacturing a semiconductor device, comprising the steps of:

5 forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

crystallizing the first amorphous semiconductor film;

10 forming a first semiconductor element by using the crystallized semiconductor film as an active region;

attaching a support to the first semiconductor element;

causing separation between the metal film and the insulating film;

15 forming a second amorphous semiconductor film over the first semiconductor element after attaching a second substrate to the separated insulating film and separating the support; and

forming a second semiconductor element using the second amorphous semiconductor film as an active region.

20 2. A method for manufacturing a semiconductor device, comprising the steps of:

forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

25 crystallizing the first amorphous semiconductor film;

forming a first semiconductor element by using the crystallized semiconductor film as an active region;

forming a second amorphous semiconductor film;

30 forming a second semiconductor element using the second amorphous semiconductor film as an active region;

attaching a support to the first semiconductor element and the second semiconductor element; and

causing separation between the metal film and the insulating film.

5 3. A method for manufacturing a semiconductor device, comprising the steps of:

 forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

10 crystallizing the first amorphous semiconductor film;

 forming a first semiconductor element by using the crystallized semiconductor film as an active region;

 forming a second amorphous semiconductor film;

15 forming a second semiconductor element using the second amorphous semiconductor film as an active region;

 attaching a support to the first semiconductor element and the second semiconductor element;

 causing separation between the metal film and the insulating film; and

20 separating the support after attaching a second substrate to the separated insulating film.

 4. A method for manufacturing a semiconductor device, comprising the steps of:

 forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

 crystallizing the first amorphous semiconductor film;

 forming a first semiconductor element by using the crystallized semiconductor film as an active region;

30 attaching a support to the first semiconductor element

by using an adhesive;

causing separation between the metal film and the insulating film;

5 forming a second amorphous semiconductor film over the first semiconductor element after attaching a second substrate to the separated insulating film by using an adhesive bond and separating the support by removing the adhesive; and

forming a second semiconductor element using the second amorphous semiconductor film as an active region.

10 5. A method for manufacturing a semiconductor device, comprising the steps of:

forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

15 crystallizing the first amorphous semiconductor film; forming a first semiconductor element by using the crystallized semiconductor film as an active region;

forming a second amorphous semiconductor film;

20 forming a second semiconductor element using the second amorphous semiconductor film as an active region;

attaching a support to the first semiconductor element and the second semiconductor element by using an adhesive; and

causing separation between the metal film and the insulating film.

25 6. A method for manufacturing a semiconductor device, comprising the steps of:

forming a metal film, an insulating film, and a first amorphous semiconductor film in sequence over a first substrate;

30 crystallizing the first amorphous semiconductor film;

forming a first semiconductor element by using the crystallized semiconductor film as an active region;

forming a second amorphous semiconductor film;

forming a second semiconductor element using the second amorphous semiconductor film as an active region;

attaching a support to the first semiconductor element and the second semiconductor element by using an adhesive;

causing separation between the metal film and the insulating film; and

10 separating the support by removing the adhesive after attaching a second substrate to the separated insulating film by using an adhesive bond.

7. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein metal oxide is formed between the metal film and the insulating film.

8. The method for manufacturing the semiconductor device according to Claim 7, wherein the separation between the metal film and the insulating film occurs between the metal film and the metal oxide film, within the metal oxide film, or between 20 the metal oxide film and the insulating film.

9. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the first amorphous semiconductor film and the second amorphous semiconductor film include hydrogen.

25 10. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the first semiconductor element is a thin film transistor.

11. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the second 30 semiconductor element is a diode or a thin film transistor.

12. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the crystallization is performed by heat treatment at such a temperature that hydrogen in the first amorphous semiconductor 5 film is released or diffused.

13. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the metal film is a single layer made of an element selected from the group consisting of W, Ti, Ta, Mo, Cr, Nd, Fe, Ni, Co, Zr, Zn, Ru, 10 Rh, Pd, Os, and Ir, an alloy material or a compound material having the element as its main component, or a laminate of the metal or a mixture.

14. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the 15 insulating film is a silicon oxide film, a silicon oxynitride film, or a metal oxide film.

15. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the second substrate is a plastic substrate or an organic resin member.

20 16. The method for manufacturing the semiconductor device according to any one of Claims 1 to 6, wherein the semiconductor device includes an optical sensor, a photoelectric conversion element, or a solar battery.

25 17. A semiconductor device comprising a first semiconductor element using a crystalline semiconductor film as an active region and a second semiconductor element using an amorphous semiconductor film as an active region over an adhesive.

30 18. A semiconductor device comprising a first semiconductor element using a crystalline semiconductor film

as an active region and a second semiconductor element using an amorphous semiconductor film as an active region over a plastic substrate.

19. A semiconductor device comprising a first 5 semiconductor element using a crystalline semiconductor film as an active region and a second semiconductor element using an amorphous semiconductor film as an active region over an adhesive,

wherein the first semiconductor element and the second 10 semiconductor element are electrically connected to each other.

20. A semiconductor device comprising a first semiconductor element using a crystalline semiconductor film as an active region and a second semiconductor element using an amorphous semiconductor film as an active region over a 15 plastic substrate,

wherein the first semiconductor element and the second semiconductor element are electrically connected to each other.

21. The semiconductor device according to Claim 17 or 19, wherein the adhesive is provided with exfoliate paper.

20 22. The semiconductor device according to any one of Claims 17 to 20, wherein the first semiconductor element is a thin film transistor.

23. The semiconductor device according to any one of Claims 17 to 20, wherein the second semiconductor element is 25 a diode or a thin film transistor.

24. The semiconductor device according to any one of Claims 17 to 20, wherein the semiconductor device includes an optical sensor, a photoelectric conversion element, or a solar battery.